CAME GROUP

URBACO

AUTOMATIC BOLLARDS

USER'S MANUAL
SIEMENS S7-224 PLC
Reference: RCPU224

THIS MANUAL IS INTENDED FOR TECHNICAL STAFF IN CHARGE OF THE INSTALLATION, THE OPERATION AND THE MAINTENANCE OF THIS PRODUCT.

CAUTION!

ELECTRICAL SHOCK HAZARD

Pictures are not contractual

NT-RCPU224(V2-EN) – V1 – 06/06

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1. PRESENTATION

1.1. General features:

This manual describes the setup and operation of the SIEMENS S7-224 PLC intended for the management of URBACO's pneumatic- or hydraulic-driven automatic retractable bollards.
This industrial-type PLC includes 14 on-board inputs, 10 on-board outputs, communication series port and LED indicators for status of inputs, outputs and PLC.
The PLC on its own can run one complete access site with weekly timer (with a TD200 or centralisation programme). Input and output expansions can be added onto the PLC to run up to 4 complete access sites.
The use of upper and lower limit switches is mandatory. They act as a safety device for operationality as well as for the detection of defaults.
In the non-centralised version, a TD200 text display unit allows for the analysis of defaults, the adjustment of programme variables, as well as the setting of weekly timer (real time clock).
In the centralised version, the PLC is connected via its RS485 port to onsite network. This network may contain several PLCs. A PC computer permits real time viewing of all details on any access location.

Directions for the good use of an access site controlled by automatic retractable bollard(s)

SAFETY RULES FOR THE GOOD USE OF AN ACCESS SITE CONTROLLED BY AUTOMATIC RETRACTABLE BOLLARD(S)

So as to ensure the good operationality of the access, for safety reasons URBACO recommends:

- To set up vertical signposts warning of an obstacle («retractable bollard») ahead.
- To equip automated systems with position lights showing bollard status (red and flashing amber)

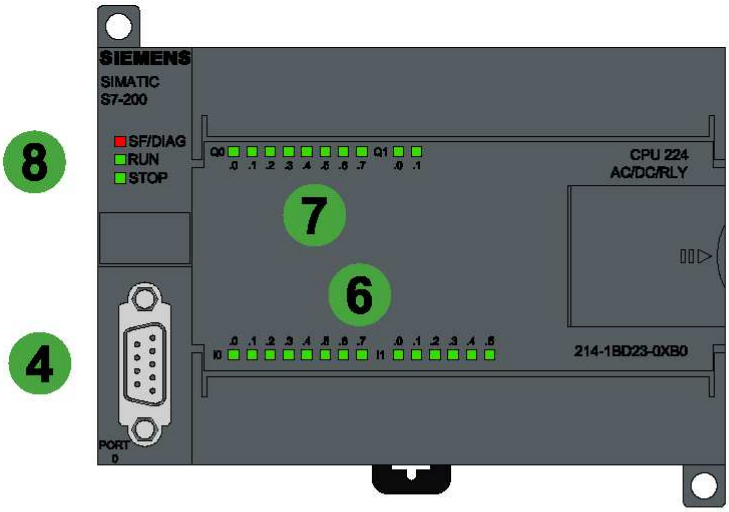
For access control systems, URBACO recommends that vehicle **be obliged to stop before the bollard and wait for its complete retraction underground** (and for the light to turn from red to flashing amber if the access site has position lights) **prior to driving on.**

For access sites programmed with bollards automatically rising once a vehicle has passed, following vehicles **must not try and drive through the access site one after the other without each stopping before the bollard, making sure it is retracted and respect signal given by position light (if such a device has been installed).**

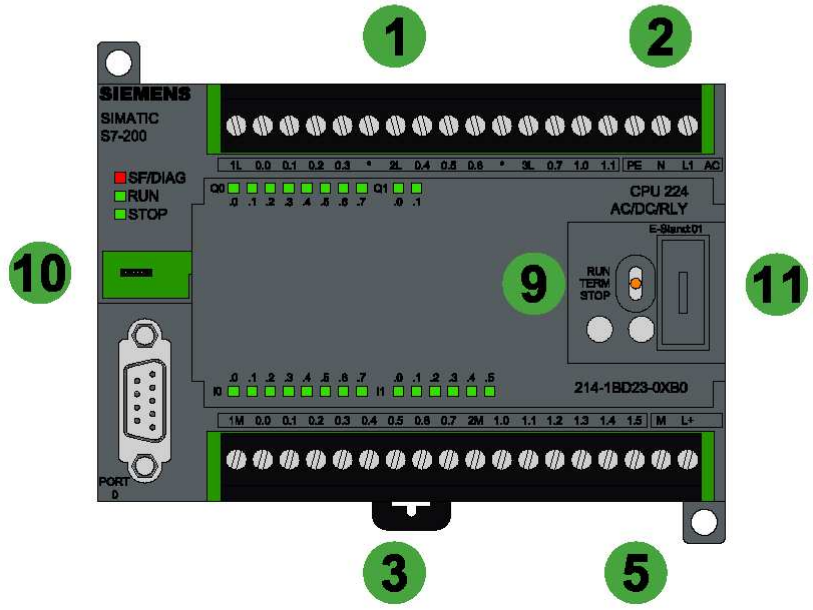
INFORMATION AND TRAINING OF USERS

The person(s) in charge of the access site is (are) bound to inform users on how to operate and utilise the access. URBACO will not be held responsible for any damage due to mishandling or to disrespecting safety rules.

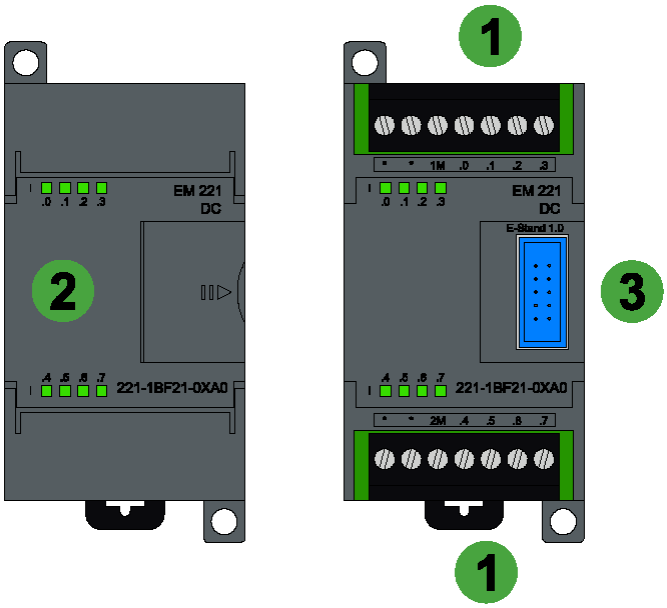
1.2. The S7-224 PLC:



1- Output connection terminal.
2- PLC supply terminal
3- Input connection terminal
4- DB9 socket for RS485 series port (TD200 or supervision network)
5- 24VDC 280mA current supply output
6- Input status LED
7- Output status LED
8- PLC status LED
9- Mode switch
10- Programme cartridge receptacle
11- Input/Output expansion connector

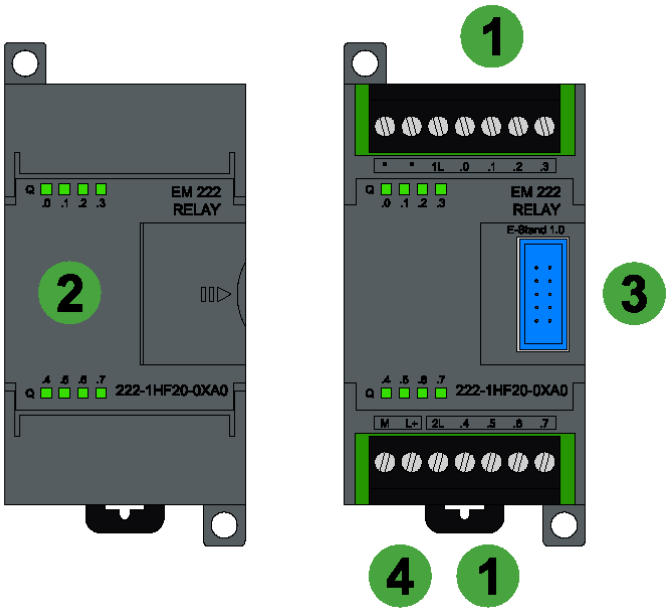


1.3. EM221 input expansion module:



1- Input connection terminal
2- Input status LEDs
3- Connector for further expansions

1.4. EM222 output expansion module:



1- Output connection terminal
2- Output status LEDs
3- Connector for further expansions
4- Module supply terminal

2. TECHNICAL DATA

CPU214 central processing unit with 220V supply, 24VDC inputs, output/relays.

Main data:

Size (L x W x H)	:	120.5 mm x 80 mm x 62 mm // *4.74 x 3.15 x 2.44 in*
Weight	:	0,410 kg // *0.9 lb*
Size of user's programme	:	8192 octets / EEPROM
Size of user's data	:	5120 octets / RAM
Backup of the dynamic date	:	190 hours typ.
Inputs/Outputs, integrated	:	14 Inputs / 10 Outputs
N°of expansion modules (max)	:	7
Real-time clock	:	built-in

Homologations:

- The LVD 73/23/EEC Low Voltage Electrical Equipment Directive
IEC 61131-2: PLCs - Prescriptions for hardware
- Directive 2004/108/EC relating to electromagnetic compatibility, repealing Directive 89/336/EEC
Standard on electro-magnetic emissions
EN 61000-6-3: Residential, commercial and light-industrial environment
EN 61000-6-4: Industrial environment
Standard on electro-magnetic immunity:
EN 61000-6-2: Industrial environment

Power supply:

Power range	:	85 to 264VAC – 47 to 63 Hz
Current on input	:	4.5 VA typ., CPU. Maximum 50 VA loading
Fuse, not replaceable	:	2 A, 250 V, slow-acting

Environment:

Temperature range	:	+0℃ to +55℃ // *+32℉ to +131℉* (95 % humidity without condensation)
Power dispensed	:	10 W
Storage temperature	:	-40℃ to +70℃ // *-40℉ to +158℉*

Inputs:

Type of inputs (IEC 1131-2)	:	Continuous voltage
Range for high logical state	:	15-30 VDC, 4 mA minimum
Nominal voltage high logical state	:	24 VDC, 7 mA
Range low logical state	:	0-5 VDC, 1 mA
Signal delay	:	I0.0 - I0.7 0.2 ms

Outputs:

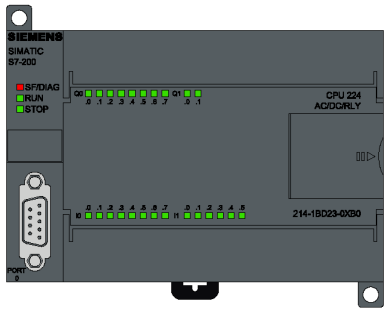
Type of outputs	:	Relays, dry contacts
Voltage range	:	5 - 30 VDC / 250 VAC
Max load current	:	2 A / Point
Overcurrent	:	7 A with contacts closed
Switch-on time	:	10 ms maximum
Life span	:	10,000,000 mechanical / 100,000 loading

24VDC supply for sensors:

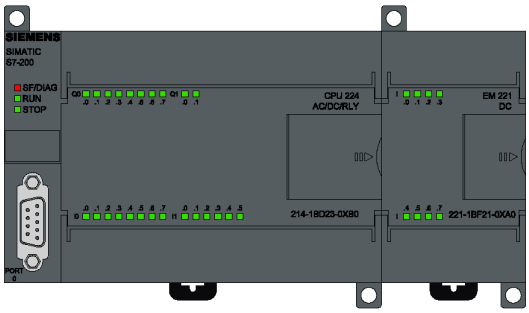
Voltage range	:	20.4 to 28.8 VDC
Residual undulation (<10 MHz)	:	1 V peak-to-peak at full load
Current available	:	280 mA
Insulation	:	No

3. CONFIGURATION OF PLC / EXPANSIONS

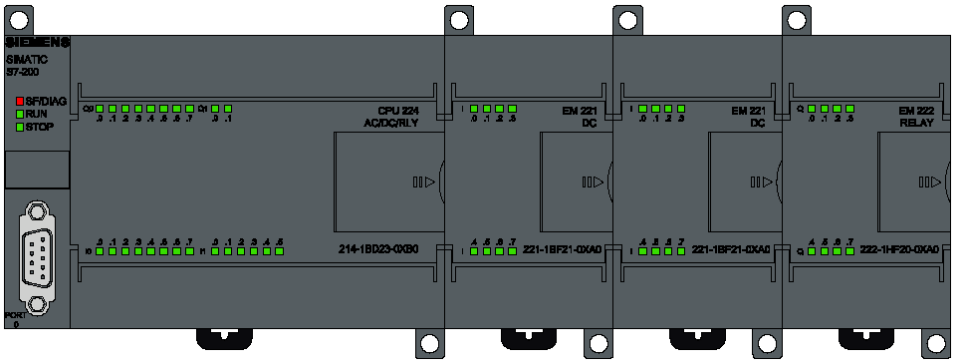
3.1. 1 access location:



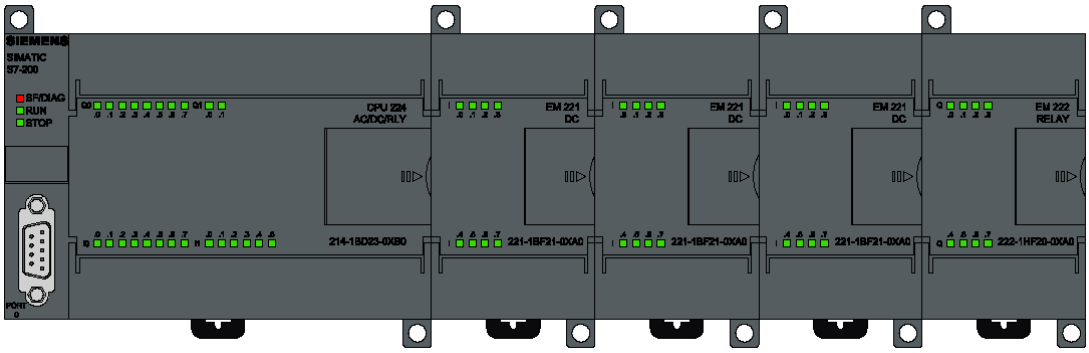
3.2. 2 access locations:



3.3. 3 access locations:



3.4. 4 access locations:



3.5. Summary table:

Number of access locations	S7-224	EM221	EM222
1	1	0	0
2	1	1	0
3	1	2	1
4	1	3	1

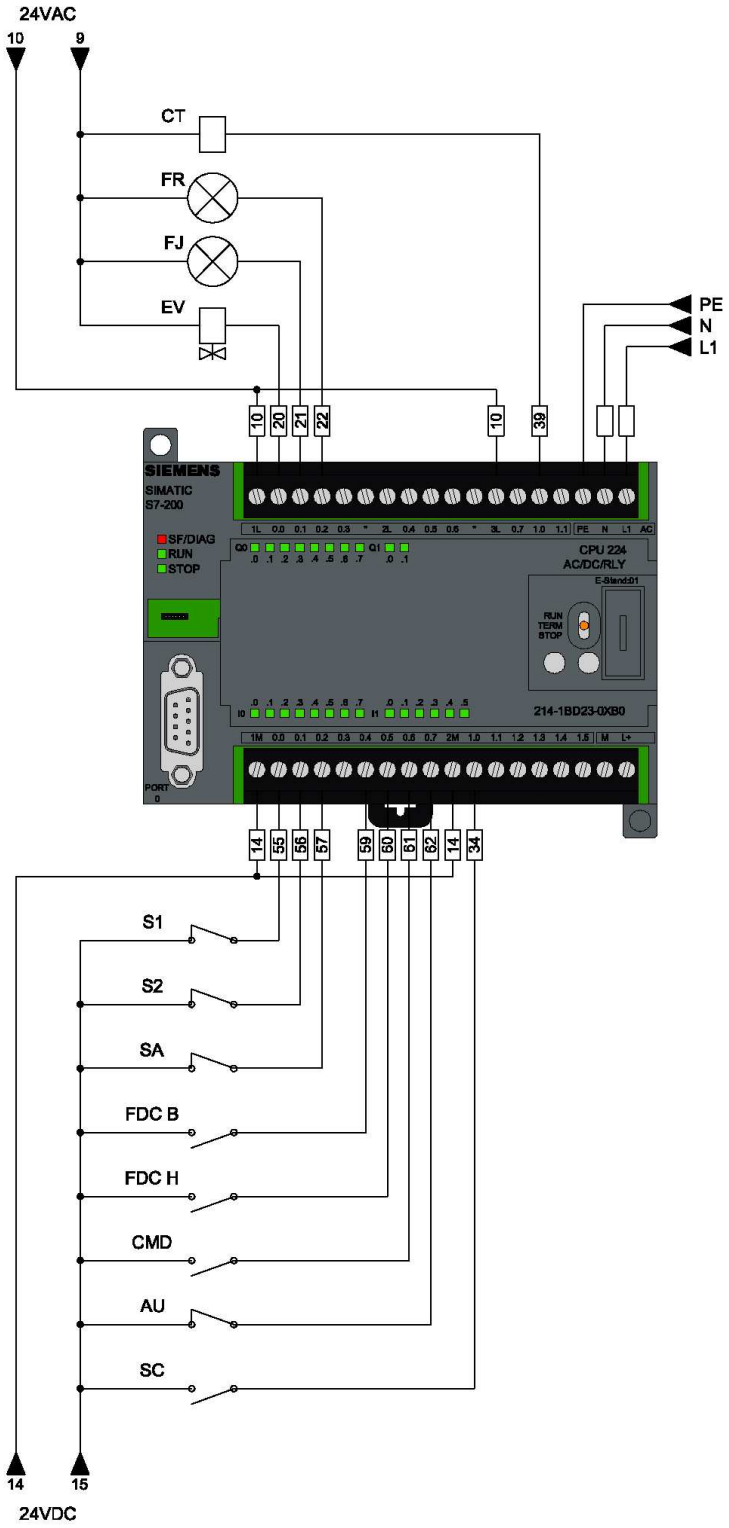
4. INSTALLATION AND CONNECTION

4.1. Fixation:

The SIEMENS S7-224 PLC as well as expansions are intended for symmetrical DIN-rail mounting. The whole set may be locked or unlocked with a hook.

4.2. Standard connections:

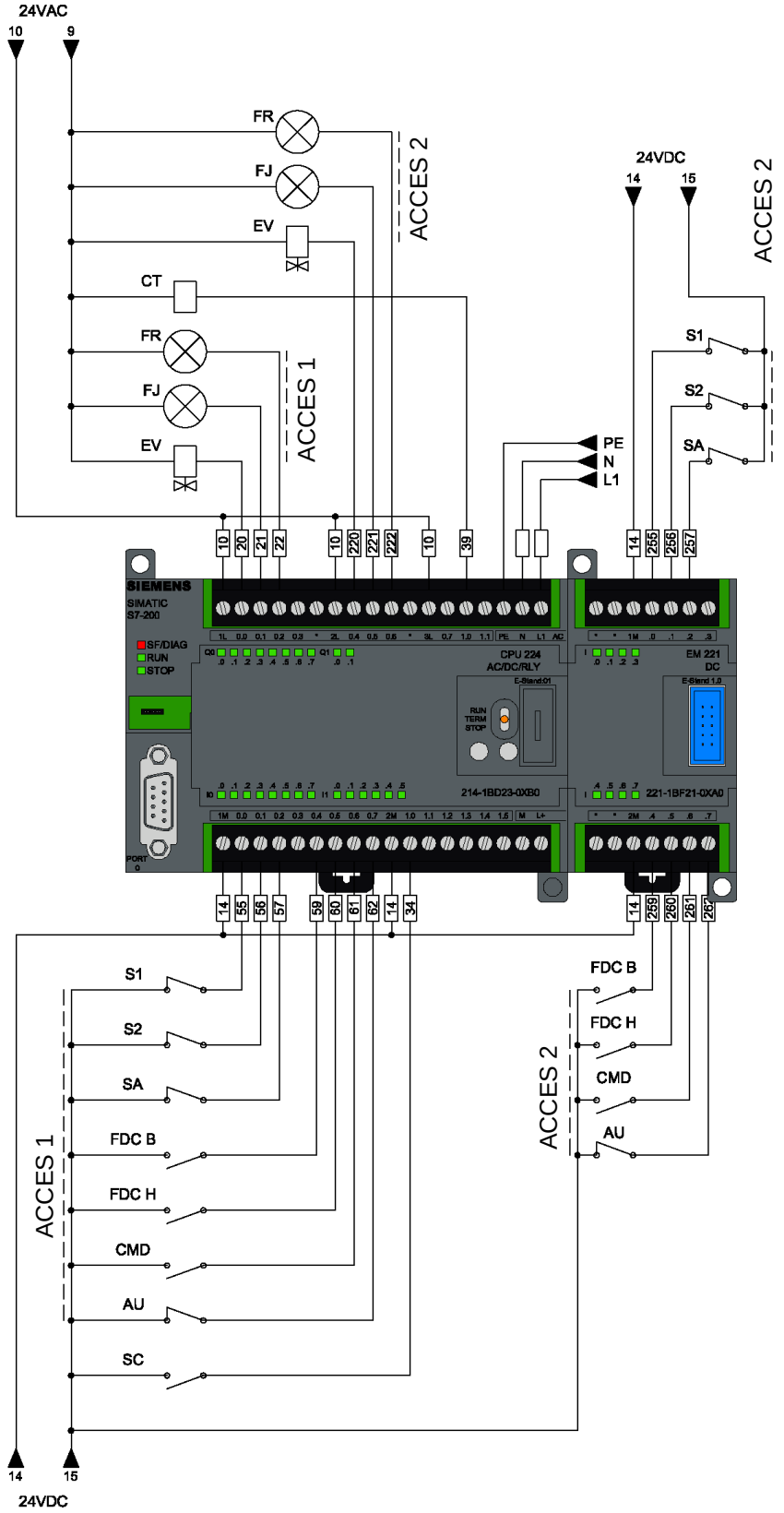
4.2.1. Standard connections for 1 access location:



Inputs:
I0.0: Contact presence / safety loop N°1 (S1 / *55*)
I0.1: Contact safety loop N°2 (S2 / *56*)
I0.2: Contact free exit loop (SA / *57*)
I0.3: External fault
I0.4: Lower limit switch (FDC B / *59*)
I0.5: Upper limit switch (FDC H / *60*)
I0.6: Descent actuation (CMD / *61*)
I0.7: Forced descent (AU / *62*)
I1.0: Compressor surveillance (SC / *34*)

Outputs:
Q0.0: Solenoid valve (EV / *20*)
Q0.1: Amber position light (FJ / *21*)
Q0.2: Red position light (FR / *22*)
Q0.3: Default
Q1.0: Contactor Motor (CT / *39*)

4.2.2. Connections for 2 access locations:

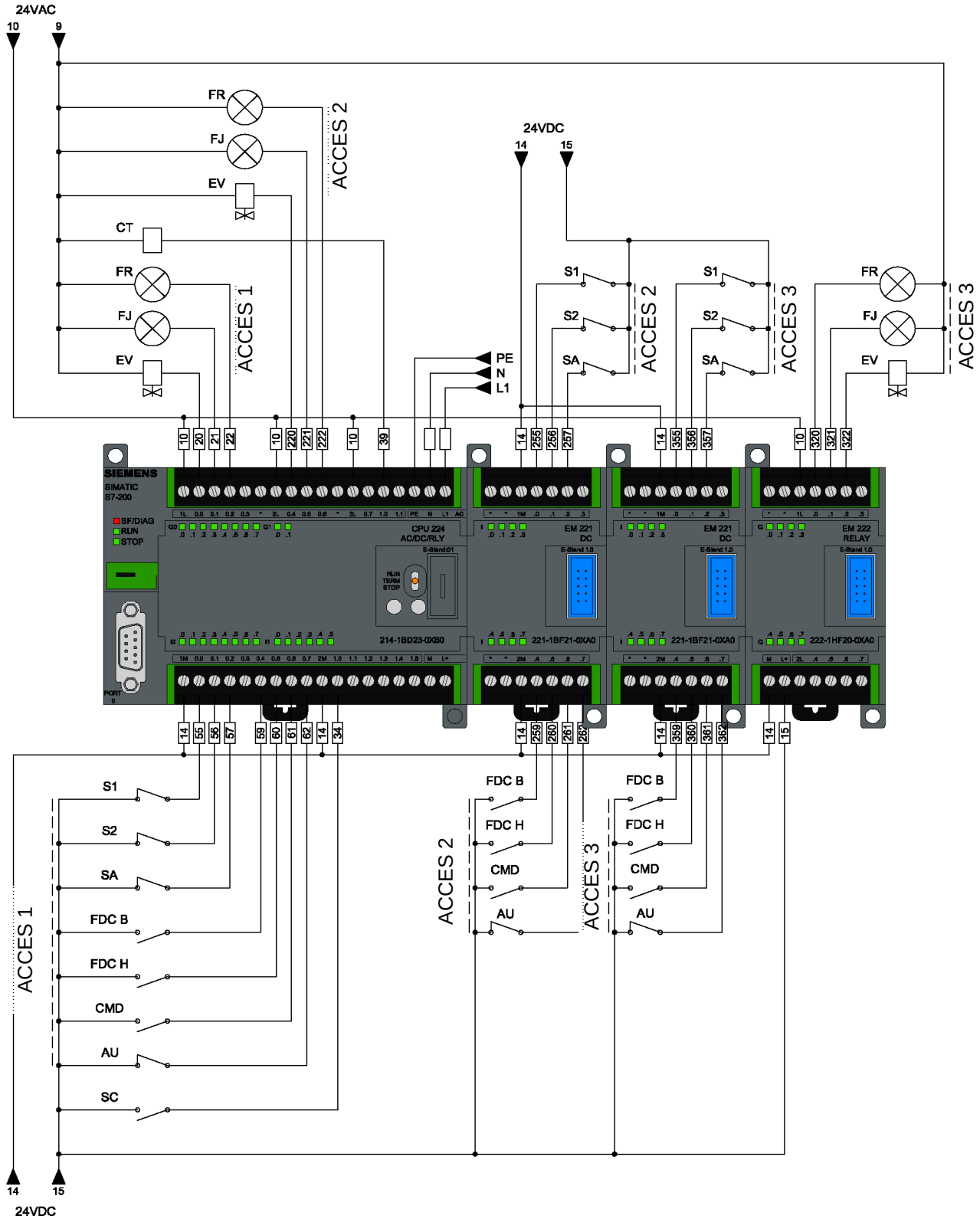


Inputs / Outputs Access N°1 as above

Inputs Access N°2:
I1.0: Contact presence/safety loop N°1 (S1 / *255*)
I1.1: Contact safety loop N°2 (S2 / *256*)
I1.2: Contact free exit (SA / *257*)
I1.3: External fault
I1.4: Lower limit switch (FDC B / *259*)
I1.5: Upper limit switch (FDC H / *260*)
I1.6: Descent actuation (CMD / *261*)
I1.7: Forced descent (AU / *262*)

Outputs Access N°2:
Q0.4: Solenoid valve (EV / *220*)
Q0.5: Amber position light (FJ / *221*)
Q0.6: Red position light (FR / *222*)
Q0.7: Fault

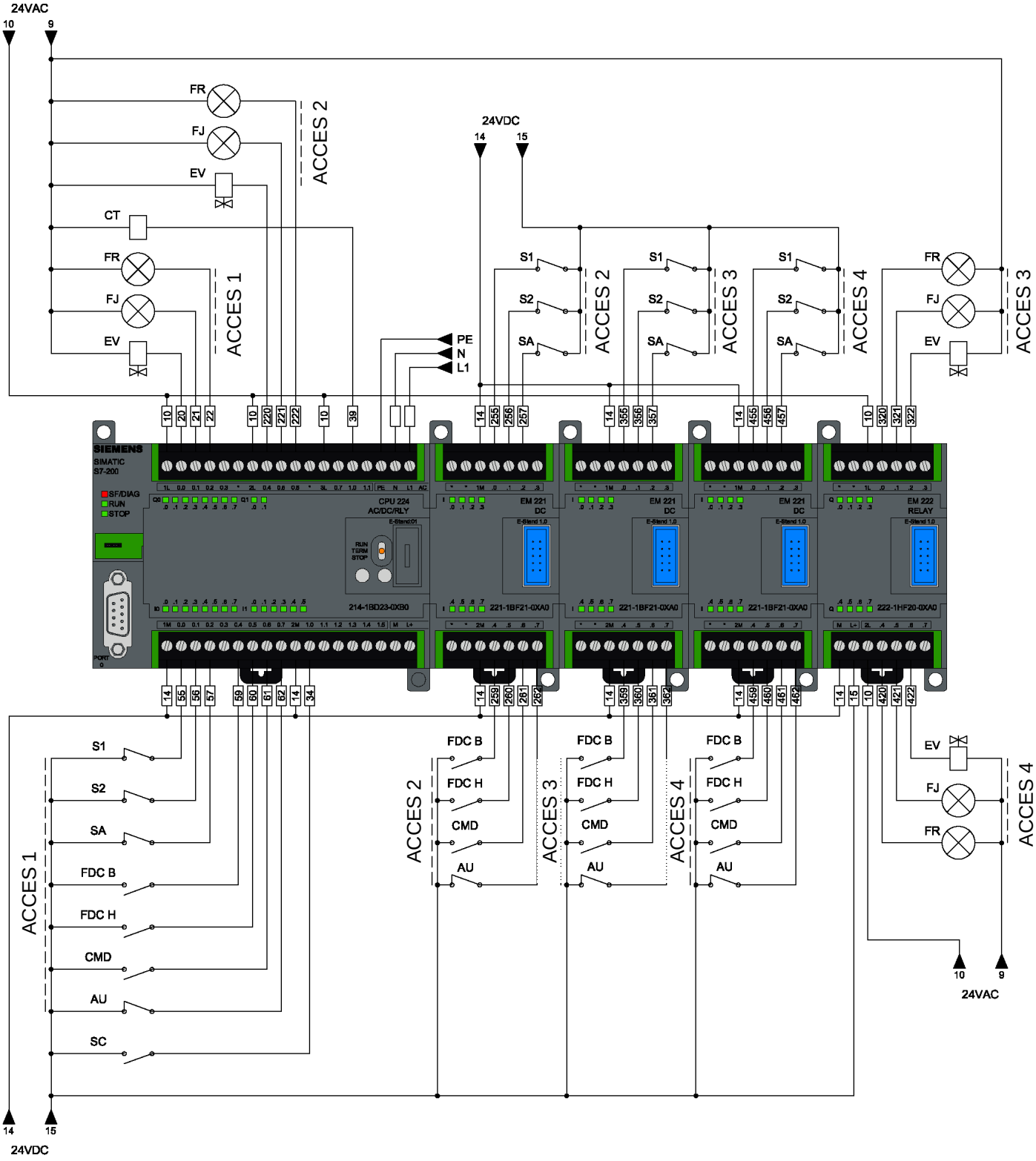
4.2.3. Connections for 3 access locations:



Inputs / Outputs Access N°1 and N°2 are as describe d above.

Inputs Access N°3:
I2.0: Contact presence / safety loop N°1 (S1 / *355*)
I2.1: Contact safety loop N°2 (S2 / *356*)
I2.2: Contact free exit loop (SA / *357*)
I2.3: External fault
I2.4: Lower limit switch (FDC B / *359*)
I2.5: Upper limit switch (FDC H / *360*)
I2.6: Descent actuation (CMD / *361*)
I2.7: Emergency stop (AU / *362*)
Outputs Access N°3:
Q2.0: Solenoid valve (EV / *320*)
Q2.1: Amber position light (FJ / *321*)
Q2.2: Red position light (FR / *322*) Q2.3: Fault

4.2.4. Connections for 4 access locations:



Inputs / Outputs for Access N°1, N°2 and N°3 are as described above

Inputs Access N°4:

I3.0: Contact Presence / safety loop N°1 (S1 / *455*)
I3.1: Contact Safety loop N°2 (S2 / *456*)
I3.2: Contact free exit loop (SA / *457*)
I3.3: External fault
I3.4: Lower limit switch (FDC B / *459*)
I2.5: Upper limit switch (FDC H / *460*)
I2.6: Descent actuation (CMD / *461*)
I2.7: Forced descent (AU / *462*)

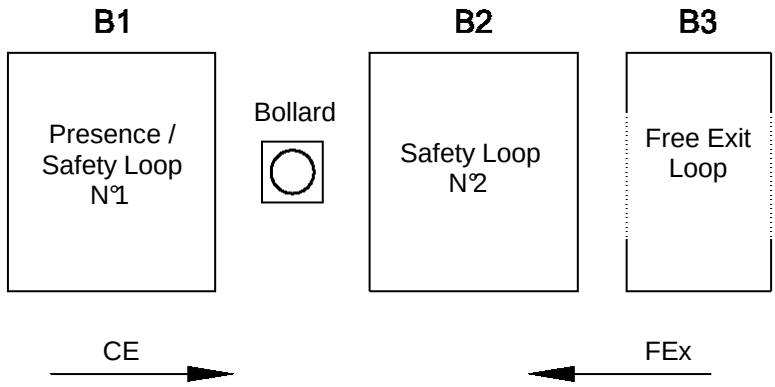
Outputs Access N°4:

Q2.4: Solenoid valve (EV / *420*)
Q2.5: Amber position light (FJ / *421*)
Q2.6: Red position light (FR / *422*)
Q2.7: Fault

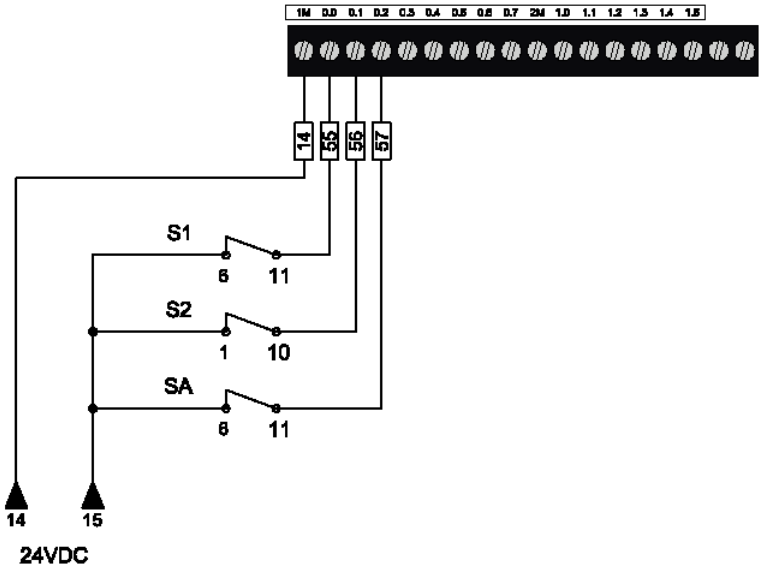
4.3. Connection of the operation logic mode:

4.3.1. Controlled entrance and Free exit:

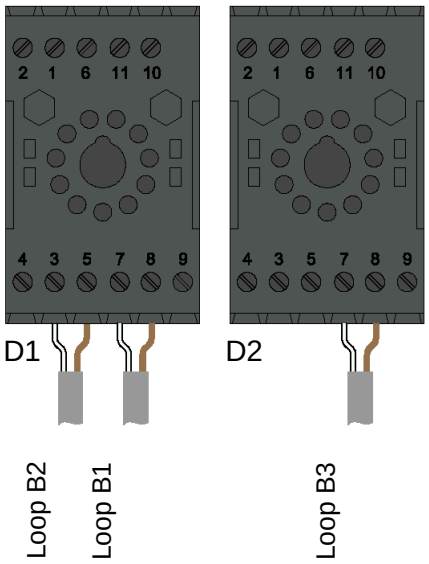
a) Installation of loops:



b) Connection of contacts:



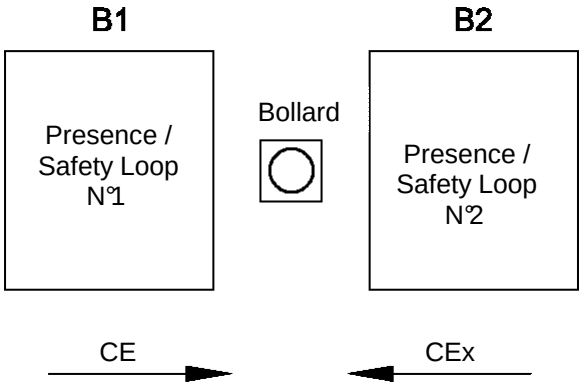
c) Connection of loops:



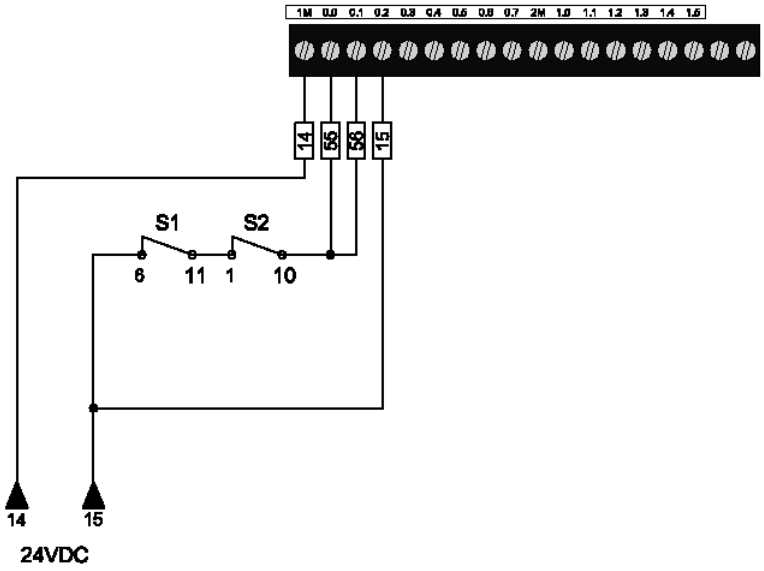
D1: Socket Detector Safety Loops (B1 and B2)
D2: Socket Detector Free Exit Loop

4.3.2. Controlled Entrance and Controlled Exit:

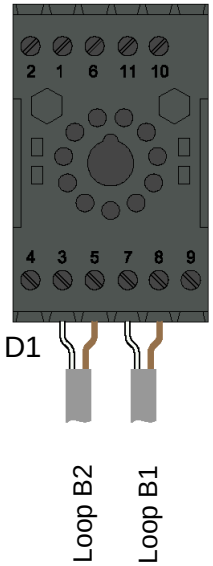
a) Installation of loops:



b) Connection of contacts:



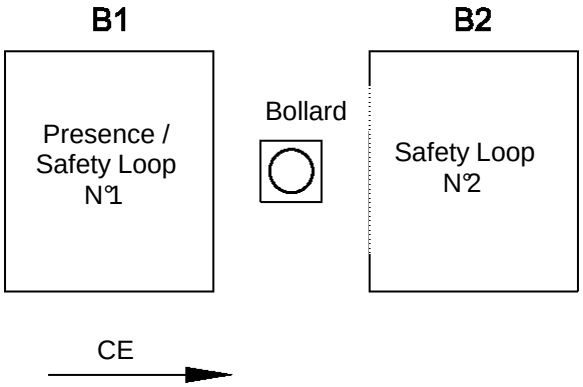
c) Connection of loops:



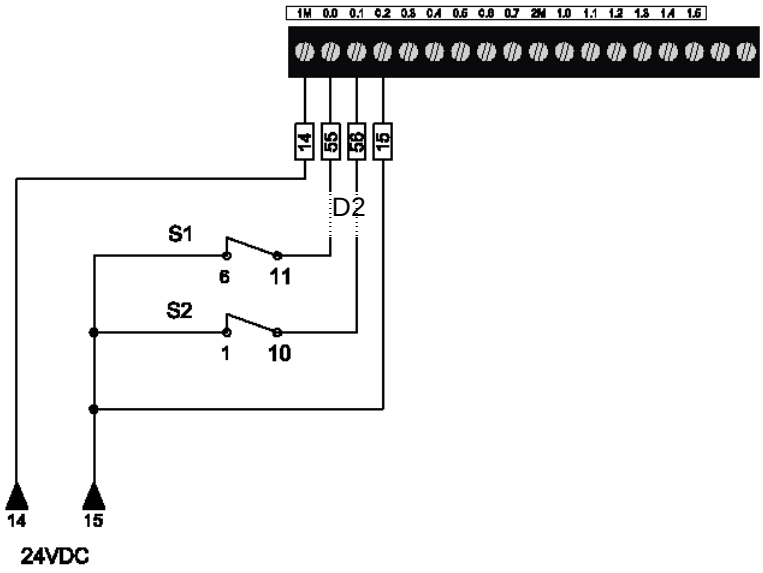
D1: Socket - Detector Safety Loops (B1 and B2)

4.3.3. Controlled Entrance and Forbidden Exit:

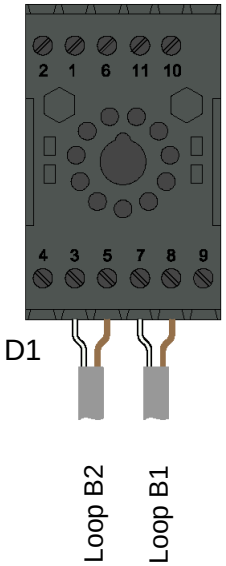
a) Installation of loops:



b) Connection of contacts:



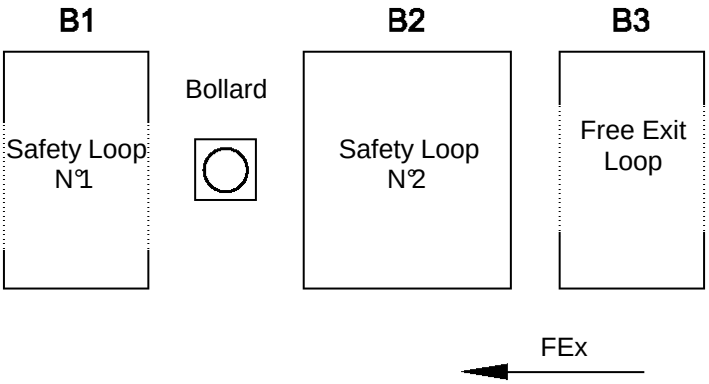
c) Connection of loops:



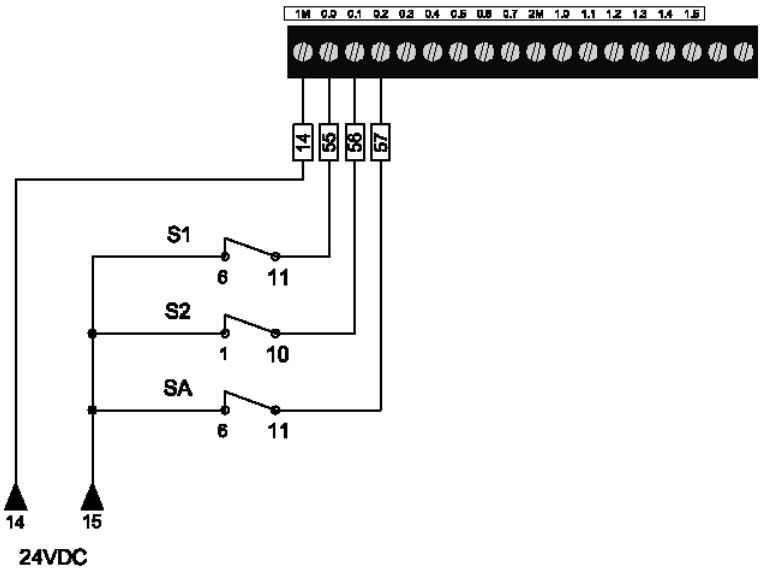
D1: Socket Detector Safety Loops (B1 and B2)

4.3.4. Free Exit:

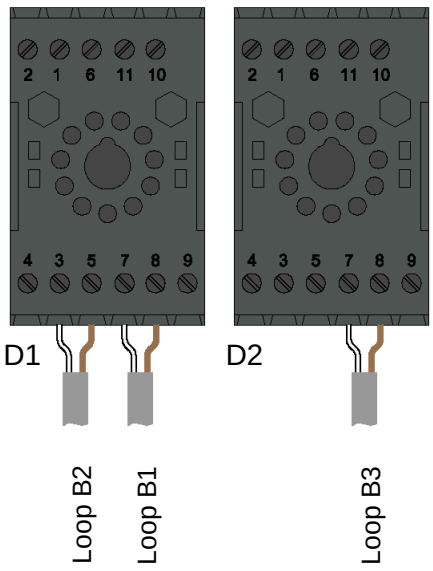
a) Installation of loops:



b) Connection of contacts:



c) Connection of loops:



D1: Socket - Detector Safety Loops (B1 and B2)
D2: Socket - Detector Free Exit Loop

5. THE PROGRAMME CARTRIDGE

5.1. Presentation:

The programme cartridge is an EEprom storing the PLC operation programme. It is used to upgrade the programme.

5.2. Programme Update and Reloading Procedure:

1) Turn the PLC switch on "STOP"; only the orange "STOP" LED should be on.
2) Completely turn PLC off. All LEDs should be switched off.
3) Remove plastic cover located underneath the PLC LEDs; the EPROM receptacle is now accessible and a mini connector should be visible.
4) Insert EPROM memory cartridge inside the receptacle (polarisation).
5) Turn the PLC back on.
6) The orange "STOP" must always be on. Turn the PLC switch on "RUN".
7) Wait for a few seconds while the content of the EEPROM memory is downloading into the PLC's main memory.
8) When downloading is finished, the PLC restarts its operation cycle and the "RUN" LED should be on. The programme is now downloaded.

Note: The memory cartridge must not stay inside the receptacle; it must be removed once down-/uploading process is over or else configuration may be lost (TD200 or centralisation) in case of a power cut. Once power is back on, the default programme and specifications contained in the cartridge would be reloaded into the PLC and zap previous configuration.

6. PLC PROGRAMMING

Two programming principles are possible:
For the non-centralised version, programming via TD200 terminal. This will be done directly on the PLC onsite.
For centralised version, via PC with Σygma II, a centralisation software developed by URBACO. This is a remote-activated operation done through the Internet.

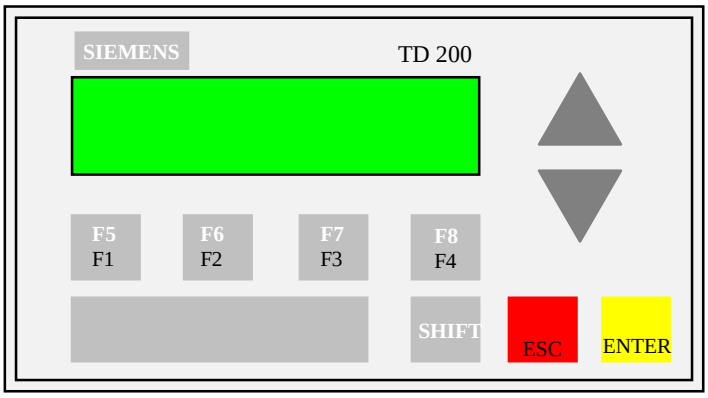
6.1. The TD200 Terminal:

6.1.1. Presentation:

The TD 200 terminal is plugged in DB9 on the PLC.
With this terminal, you can modify position light operation mode, change time lapse delays, visualise operation defaults and change automatic opening time frames. It may be connected permanently or just in case. It consists of a display screen (2 lines of 20 characters each) and function keys.

Keys:

F1	:	Access programming
F2	:	Access weekly timer programming
F3 to **F8**	:	Not used
▲	:	Visualisation of messages off screen or selection of a variable
▼	:	Visualisation of messages off screen or selection of a variable
Esc	:	Access time set menu or escape
Enter	:	Enter, validate data
Shift	:	Key not used



6.1.2. Programming:

The TD200 terminal is used to programme the operation mode of position lights, time lapse delay before automatic bollard rise, time lapse delay before time lapse or push button, compressor surveillance time, time frames for forced openings (two per day) and the PLC internal clock (date and time).

Position light operation modes:

The following table chart gives you a selection of values for the programming of position lights depending on the operation mode requested.

Amber light: - stands for light status when bollard is retracted (down).

Red light: - Notification / Pre-warning: time when red light is flashing between safety loop clearance and bollard rise.
- Rise: stands for light status during bollard rise phase.
- Descent: stands for light status during bollard descent phase.
- Upward: stands for lights status when bollard is upward.

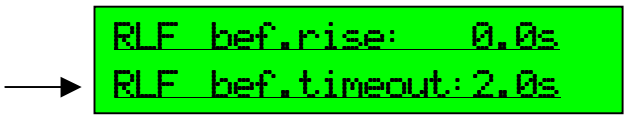
Value	**Amber light**	**Red light**			
	Bollard Down	**Notification / Pre-warning**	**Bollard Rise**	**Bollard Descent**	**Bollard Upward**
0	Flashing	Flashing	Flashing	Flashing	Steady
1	Steady	Flashing	Flashing	Flashing	Steady
2	Flashing	Flashing	Steady	Flashing	Steady
3	Steady	Flashing	Steady	Flashing	Steady
4	Flashing	Flashing	Flashing	Steady	Steady
5	Steady	Flashing	Flashing	Steady	Steady
6	Flashing	Flashing	Steady	Steady	Steady
7	Steady	Flashing	Steady	Steady	Steady

Note: Default value is set on 0.

Time lapse delay / Notification before automatic rise:

To visualise or modify time lapse delay, proceed as follow:
1) Press "F1"
2) Move arrows along selected line
3) Press "Enter" to modify time
4) The cursor is positioned on time lapse delay
5) Change time with arrows, then validate with "Enter"

Time lapse delay / Notification before rise, after time lapse delay or actuation with push button:



This is the pre-warning notification time before the bollard effectively rises back when the push button is released or current time lapse frame nearly over.
To visualise or modify time lapse delay, proceed as follow:
1) Press "F1"
2) Move arrows along selected line
3) Press "Enter" to modify time
4) The cursor is positioned on time lapse delay
5) Change time with arrows, then validate with "Enter"

Compressor surveillance time:

This time frame is meant for turning compressor off in case of a leak within the air circuit.

To visualise or modify compressor surveillance time, proceed as follow:
1) Press "F1"
2) Move arrows along selected line
3) Press "Enter" to modify time
4) The cursor is positioned on compressor default time
5) Change time with arrows, then validate with "Enter"

Forced opening time frames:

These frames are meant to define at which time the access should be open (bollard down) for each day of the week for as much as two time slots (TS) per day.

Caution! A time frame overleaping two days (e.g. 11:00 p.m. to 06:00 a.m.) must be programmed in two parts: from 11:00 pm to 00:00 midnight the first day and 00:00 (midnight) to 06:00 am the day after.

To visualise or modify time slots, proceed as follow:
1) Press "F2".
2) Move arrows along selected line
3) Press "Enter" to modify time slot
4) The cursor is positioned on the opening time
5) Change time using arrows, then validate with "Enter".
6) The cursor is positioned on the closing time.
7) Change time using arrows, then validate with "Enter"

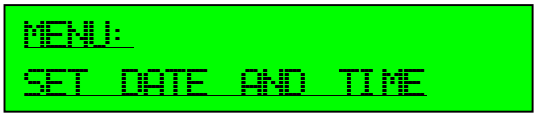
Time frames are formatted as "HHMM". HH must be included between 0 and 24 and MM between 0 and 59.

This function may be repeated as many times as needed.
To delete display, press again "F2".

The opening time is within the time frame whereas closing time is off that time frame.

To have no opening time frame, simply enter identical opening time and closing time frames.

The PLC internal clock:

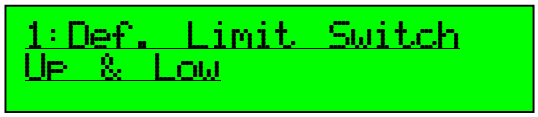


Setting of the PLC real-time clock:
The time entered will be the reference time for access opening time frames.

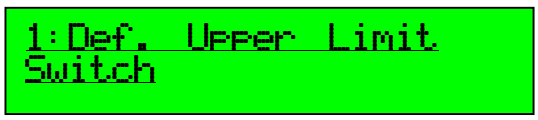
Press "Esc."
Message "Menu:" is displayed
Using arrows, select: "Set Date and Time"
Validate by pressing "Enter".
Modify values using arrows and validate each value by pressing "Enter".
To escape, press "Esc."

Default display screens:

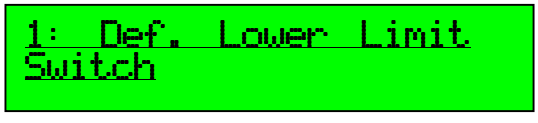
It is possible to visualise the PLC defaults.
The first figure stands for the concerned access number.



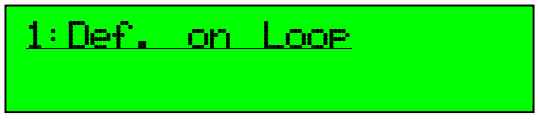
Both limit switches are actuated at the same time.



The upper limit switch was not reached after 30 seconds.



The lower limit switch was not reached after 15 seconds.

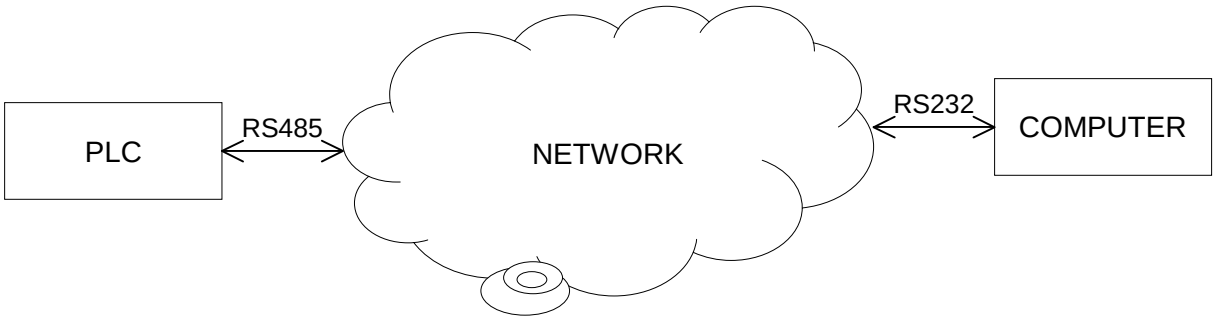


There is an anomaly on one of the 3 loops. It may either be a default on loop, or on detector, or a vehicle has been parked over for more than 0 minutes.

6.2. Centralisation :

A PLC is centralised when it is linked to a site network via signal converters all the way to a PC computer possessing the Σygma2 supervision software.
The network may be structured in different ways (RS485 wired, fibre optical, IP…).
This paragraph does not aim at giving all details on possible centralisation types but is intended to give a hint or a quick overview on what a supervision network is all about.
The PLC has a RS485 port permitting data exchange with the Σygma II software. All information on access location is transferred in real time to the software (limit switches, defaults, loops, etc) Moreover, this software can download time frames, opening actuation orders as well as internal variables inside the PLC.

Structural principle of network between a PLC and the computer (PC):
The network comprises converters and links.



This network makes the transfer of data feasible over a distance depending on communication type.

For further details, see the directions for use of the Σygma II centralisation software.

7. OPERATION

7.1. Power on:

(When all connections have been realised and when programme has been downloaded into PLC). The bollard is down (retracted).
The amber light is flashing.
If the loops are cleared, the red light flashes during time lapse delay before rise (programmable).
At the end of this period, the bollard rises.
The red light is flashing or remains steady depending on programme entered for this situation.
Once the bollard is upward, the red light is on steady red.

7.2. Power outage:

The bollard goes down (retracts).
When power is back, see §7.1.

7.3. Operation on an automatic descent actuation (normal passage):

The command for descent will only be considered if a vehicle is detected on presence/safety loop N°1. In this situation, the bollard immediately goes down (retracts), the vehicle passes through and the bollard rises back once the safety loops (B1 and B2) have been cleared and time lapse delay before rise (depending on programme entered).

7.4. Operation: forced descent:

When the push button is engaged (I0.7=0), the bollard immediately goes down (retracts underground) and remains as such for as long as the button is engaged. When the push button is released, (I7=1), the bollard rises again as for a normal passage.
The push button also validates faults and enables system to re-start (see 7.15).

7.5. Operation on free exit:

If a vehicle presence is detected at the same time over the free exit loop and the safety loop N°2 for as long as 2 seconds (adjustable), the bollard will automatically go down (retract).
The bollard rises again as for a normal passage.

7.6. Safety during bollard rise:

When the bollard is rising, any presence detected over safety loops will result in the immediate descent of the bollard for as long as the upper limit switch is not activated.

7.7. Locking in the upward position:

As soon as the upper limit switch is activated (bollard in the upward position), the bollard is locked up and no detection on loops will trigger the bollard down.

7.8. Operation of compressor surveillance (for pneumatic installations):

A dry contact from the pressure gauge is used to control the length of time when the compressor is on duty. When the motor is on, the contact is closed; when the motor stops, the contact opens. As soon as the compressor starts, time lapse delay starts as well and if, after 3 minutes (or as programmed for centralisation) the compressor is still on, one will assume there is an air leak somewhere and operating will stop.

7.9. Compressor management (for pneumatic installations):

The compressor works on its own. The 230V power supply is continuous in normal operating mode. The pressure gauge integrated in the compressor controls the start / stop status of the compressor to maintain air pressure within the circuit.

7.10. Operation of the hydraulic group (for hydraulic installations):

Motor start / stop actuation is operated from the PLC. The group is only powered to make the bollard go up. When the upper limit switch is activated, power is supplied to the group for 1 second to pressurise circuit before it stops. The solenoid valve built in the hydraulic group circulates the oil between the receiver and the cylinder.
Detail of operation stages (standard group):
EV=1 and motor =1: the bollard rises
EV=1 and motor =0: the bollard is maintained upward
EV=0 and motor =0: the bollard goes down (retracts)

7.11. LED status indicators:

Each input and each output is associated with a LED showing status.
Three additional LEDs give indications on PLC status:
SF: switched off = normal. Switched on = serious malfunction within the PLC.
RUN: switched on = mode RUN, programme runs.
STOP: switched on = mode STOP, programme stops.

7.12. Fail-safe device (negative security):

For pneumatic installations, a solenoid valve (normally closed) is connected to the main solenoid valve exhaust. This solenoid valve is permanently powered (exhaust possible). In case of a power outage, exhaust is no longer possible and the bollard remains upward.

For hydraulic installations, a specific group is designed with solenoid valve (normally closed) and manual descent lever. The programme will also be specific.

7.13. Maximum number of bollards per access:

For pneumatic installations, the number of bollards is determined by:
1) The solenoids valves used. Each PLC output only tolerates a maximum of 2A current.
2) The type of compressor used. A table chart gives indications on how many bollards are suitable by compressor.
For hydraulic installations, the number of bollards is determined by:
1) The volume of oil taken from the group receiver for the whole circuit.
2) How much time it takes for the bollards to rise compared to applicable standards (max 10 seconds)

7.14. Position Lights:

Red Light:
- Steady when the bollard is upward.
- Flashing when the bollard is in motion as a standard, but adjustable with TD200 or centralisation.

Amber Light:
- Flashing when the bollard is down.

Note: Upper and lower limit switches are obligatory for the management of traffic (position) lights.

7.15. Defaults:

Default (pneumatic)	Time	Adjustable?	Reaction	Status of Lights
Compressor surveillance	5min	Yes	Default (bollard down)	Red
Loss of limit switch when bollard is locked upward	---	---	No default	Red, flashing
Upper and lower limit switches, simultaneously	---	---	If bollard locked upward: no default Else: default (bollard down)	Red, steady
No limit switch	45s	Yes, for centralised installations	If bollard locked upward: no default Else: default (bollard down)	Red, flashing
No upper limit switch during rise phase	45s	Yes, for centralised installations	If bollard locked upward: no default Else: default (bollard down)	Red, flashing
No lower limit switch during descent phase	15s	Yes, for centralised installations	If bollard locked upward: no default Else: default (bollard down)	Red, flashing
Vehicle parked over loop	10min	Yes, for centralised installations	Information relayed	Normal

Default (hydraulic)	Time	Adjustable?	Reaction	Status of Lights
Hydraulic group operating	10s	Yes, for centralised installations	Default (bollard down)	Red
Loss of limit switch when bollard is locked upward	---	---	No default. Group starts again.	Red, flashing
Upper and lower limit switches, simultaneously	---	---	If bollard locked upward: no default Else: default (bollard down)	Red, steady
No limit switch	10s	Yes, for centralised installations	Group starts again and time lapse delay begins	Red, flashing
No upper limit switch during rise phase	15s	No	Time lapse delay begins and default (bollard down)	Red, flashing
No lower limit switch during descent phase	10s	Yes, for centralised installations	Default (bollard down)	Red, flashing
Vehicle parked over loop	10min	Yes, for centralised installations	Information relayed	Normal

In default mode, outputs Q0.3 (Access N°1), Q0.7 (Access N°2)… are activated to signal default.
The push button / forced descent validates default (reset).

8. MAINTENANCE

No special maintenance is prescribed for the PLC. Technical checkups are however recommended every now and then to control the overall state of equipment (dust, moisture…), safety elements (vehicle detection, sensors), operationality of actuators (beepers, contactless cards…) as well as to tighten loose screws if necessary.
Periodicity of checkups is left to operator's judgement depending on where the system is installed and how often it is on duty (intensive use or not).

9. TROUBLE SHOOTING

Problem	Solutions
PLC is switched off	- Check power supply - Check connections - Check fuses
SF LED light is on	- PLC software is faulty. Reload programme.
External actuator is not active	- Check power supply and connections - Check that not vehicle presence has been detected - Check programming or/and configuration
Bollard will not rise	- One of the safety sensors has detected something. Clear perimeter of anything likely to be detected. - One of the safety sensors is «hooked»: Reset sensor without any vehicle over loops - Push button for forced descent is on - Check all LEDs on PLC - One of the time slots is still active - A forced actuation from Centralisation is active
Traffic lights are not working properly	- Check connection of position lights and/or limit switches (inversion)
Compressor will not start	- Check fuses - Check connections - Check compressor

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